

How to make LFAS totally freak out - "The phantom submarine"
by Lee Tepley, PhD, Physics
5-31-01

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5-31-01

(3 pages including this page)

Dear Ms. Weiting:

This document is a supplement to a long technical paper that I mailed to you yesterday before the deadline. Although this document is written in a slightly humorous way and is addressed to LFAS protesters, I think that NMFS should take it very seriously. I also think that the recent NMFS hearings on LFAS were probably a farce and that NMFS is willing to go along with anything the Navy wants because of the Navy's "National Security" argument. I think that this argument is a cover-up for the Navy's desire to keep a dinosaur-type project from going into extinction and that NMFS should seriously reconsider blindly going along with the Navy. My reasons for thinking this way are as follows:

The Navy's main argument for LFAS comes down to the statement that it is needed for "National Security". Frankly, I think that NMFS will go along with this argument and the judicial system may go along as well. Our main hope is that Congress will kill the LFAS program - but even Congress may be swayed when the Navy states that LFAS may save us from nuclear destruction.

So what can be done to really effectively counter the "National Security" argument. We can invoke the "Phantom Submarine" to totally screw up the LFAS system. So what the hell is a "Phantom Submarine"??? It is a simple, economical counter-measure to LFAS and it just might be the answer to the "National Security" argument - so read on and try to tolerate a little technical stuff as painful as it may be. You might even tell your Congress person about it instead of just signing petitions about how LFAS will kill whales. It may certainly do that but there may be many in Congress who could care less because whales don't vote or contribute to political parties.

The above may sound like I have finally cracked up from spending too much time writing about LFAS - but I don't think so (at least not yet). The "Phantom Submarine" argument hit me while I was tossing around in bed a few nights back. I am amazed that it did not hit me sooner. Certainly, the Navy has to be well aware of this simple counter measure but they could just be in heavy denial.

So here goes!! Basically a "Phantom Submarine" would consist of the following:

1. A simple inexpensive hydrophone: It could be mass-produced for about \$5.00 each. I still have some lying around from World War II sonabuys.
2. An inexpensive battery powered amplifier: A power output of one watt would be more than enough*. You can buy one at the Radio Shack for about \$10.
3. An underwater Loud-speaker. This would cost a bit more. I don't think you could get away with just putting an air-type loud speaker in a bottle.

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4. A digital time delay circuit: This would also cost a few bucks but - in this high tech age - it should not cost all that much.
5. A styrofoam float (or it's equivalent) to keep the Phantom submarine from sinking to the ocean bottom.

Basically, that is all you would need to build a "Phantom Submarine". So how would it work??

First you put the above items together in a neat little package which would probably weigh about 1 pound. Then you can drop it out of an airplane, lower it into the water from a boat, deploy it from a real submarine or maybe even anchor it on the ocean bottom. Of course you would not really do anything like this (because NMFS might fine you for putting sound into the water) but maybe an evil enemy of the United States would.

Now you know how you (or an evil enemy) can build and deploy a "Phantom submarine" - but I still haven't told you how it works. That comes next.

As it floats in the ocean (or maybe hangs below a boat or whatever), the hydrophone picks up the sound wave from the LFAS ship which could be a very long ways off. The signal from the hydrophone is then amplified, fed through the time delay and then into the underwater speaker which radiates the time-delayed LFAS sound back into the water. Part of the radiated sound wave eventually finds it way back to the LFAS ship where it is received by the towed hydrophone array and fed into the ships sophisticated computer. Since it looks just like the LFAS signal that would be reflected from a real submarine, the computer can't tell the difference. It thinks it has detected a real submarine but, in reality, it has only detected a very little "Phantom Submarine" which can look very big. It all depends on just how much the LFAS sound is amplified before being radiated back into the water.

The "Phantom Submarine" can even be made to move away from the LFAS ship by varying the digital time delay. This is because the LFAS computer determines distance by measuring how long it takes the LFAS signal to return after it bounces off of a real submarine. Hence, by varying the time delay between the received and re-radiated LFAS signal, the "Phantom Submarine" can change it's apparent distance from the LFAS ship. (However, it might be tough to make it move sideways or come too close to the LFAS ship.)

So would this simple idea really work. The only problem I can think of is something that technical types call "positive feedback"; that is, the radiated signal from the little loud speaker might be picked up by the little hydrophone and fed back into the little amplifier. It would then go round in circles and the radiated signal would turn into a continuous howl. To help solve this problem it might be a good idea to place the hydrophone far from the amplifier and the loud speaker - like maybe 100 meters away. This doesn't complicate things very much. By combining this with the digital time delay (and maybe making a few other modifications) this potential problem should be fairly easily solved. After all, the LFAS ship has the same problem. Part of the LFAS sound wave that it puts out also goes directly to it's towed hydrophone array.

The Navy will probably ignore the suggestion that a "Phantom Submarine" can screw up it's LFAS system. It may also say that it knows best and that outsiders know nothing about naval strategy and should just go away and keep quiet. It might even say that it can tell "real" and "phantom" submarines apart because the sound waves from the "real" and

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"phantom" submarines will be different. But how different can the sound waves really be?? Maybe a little different but how will the sophisticated LFAS computer cope if it simultaneously receives LFAS return signals from 10 different directions from 10 phantom submarines?? - or maybe even from 100 phantom submarines!! They are small, easily deployed and don't cost very much. We are talking serious overload here. The sophisticated LFAS computer might be smart enough to guess that it is dealing with a Phantom submarine fleet but how will it know if maybe just one of the so called "phantoms" is actually a real submarine. While the computer struggles with this incredible high tech problem, the real submarine could sneak off into the cold dark waters or maybe even launch a nuclear-tipped missile. This would be terrible - but how could the befuddled LFAS computer help to keep it from happening?? I don't think that it could help at all. It could only give a totally false sense of "National Security".

It seems to come down to the fact that an enemy submarine will be detected by LFAS only if and when it doesn't mind being detected. If it wants to avoid detection, all it has to do is arrange for a lot of decoys - or "Phantom submarines" - to appear out of nowhere, re-radiate a lot of LFAS signals and totally screw up the LFAS computer.

I think the above scenario should put a big dent in the "National Security" argument. Clearly LFAS would do a pathetic job of protecting a naval fleet (or anything else) from surprise attack from an enemy nuclear submarine hidden among a fleet of phantoms. But LFAS cannot even turn itself on without acoustically lighting up the ocean for about 100 miles around and giving away the location of the Naval fleet which it is supposed to protect. Furthermore, since the LFAS ship towing its heavy cable of 18 projectors, can only lumber along at about 5 knots, it can't even keep up with the fleet without pulling its cable out of the water. Then it would have to race ahead of the fleet before it could slow down and light up the ocean again. Maybe it is better if it does not light up the ocean and injure or kill cetaceans in the process. Maybe it's better if it just disappears. There are lots of better ways to waste tax-payers money.

One final point: A real enemy submarine with a passive sonar system will know that the LFAS ship is in the neighborhood long before the LFAS ship has the slightest idea that a submarine is anywhere close. This is because the sound wave from the LFAS ship will be a lot louder at the submarine than it will be after being reflected back to the LFAS ship. The submarine will have a lot of advantages. It may even be able to save it's fleet of little phantom submarines for special occasions.

*It may seem surprising that a 1 watt amplifier could put out enough acoustic power to be picked up by a distant LFAS ship. But consider that ATOC puts out less than 200 watts of acoustic power which is equivalent to about 195 dB and it's sound wave can be picked up about 3000 miles away. A simple calculation shows that 1 watt of acoustic power is about 170 dB. It all has to do with the propagation of sound in water. Things are a lot different in water than in air.

Sincerely,



Lee Tepley, PhD, Physics